Example of Relationships among BDCP Goals, Objectives, Conservation Measures, and Adaptive Management

Note: *Box numbers referenced in each of the following sections correspond to box numbers indicated in Figure 1.*

BDCP Planning Goal:

> **Provide for the conservation and management of Covered Species within the Planning Area.**

Box #1

BDCP Preliminary Conservation Objective:

> **Preserve and restore habitat and contribute to the recovery of Covered Species.**

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Box #2

Goal ECSY 2: Increase primary and secondary production to increase the abundance and availability of food for all life stages of covered fish species.

> ***Problem Statement:*** *Food production and availability is believed to be a major factor limiting the abundance of covered fish species.*

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Box #3

Objective ECSY2.1: Over the term of the BDCP, increase the abundance of zooplankton species that provide food and support food production for covered fish species in Delta waterways.

> ***Problem Statement:*** *Insufficient abundance of zooplankton in the Delta, as a food source, is believed to be a factor limiting the abundance of delta smelt and longfin smelt and the abundance of invertebrates and vertebrates that are food for other covered fish species.*

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Box #4

> **Objective Monitoring Metric #1: Zooplankton (number/1,000 m^3)**

Early Target: Provide for a year over year increase in the mean abundance of zooplankton sampled at [[*Delta waterway locations*]] during winter, spring, summer, and fall relative to mean abundance present during these periods from 200_ to 20__ until the overall target is achieved.

Overall Target: Increase the mean abundance of zooplankton sampled at [[*Delta waterway locations*]] by at least __ percent during winter, __ percent during spring, __ percent during summer, and __ percent during fall relative to mean abundance present during these periods from 200_ to 20__.

Box #5

Adaptive management triggers and responses: If zooplankton abundance in Delta waterways does not trend towards achieving the targets as conservation measures are implemented, the Implementing Entity will undertake investigations to identify potential causes or determine if the target were established incorrectly given the uncertainties surrounding the internal and external factors that govern the capacity of the Bypass to produce these constituents., including review of zooplankton production and abundance monitoring results for the conservation measures. The Implementing Entity will also review any new relevant information related to the understanding of covered fish species stressors and status (e.g., research and system monitoring results) to determine if further actions are necessary to achieve the biological goals and objectives. For example, if new information indicates that the abundance of zooplankton is no longer considered a factor limiting covered fish species or if the status of covered fish species in the Planning Area have achieved or are trending towards achieving species biological goals and objectives, it may be determined that additional actions are not required to increase zooplankton production.

If additional actions are deemed necessary to increase zooplankton production and the likely cause is associated with lower than anticipated zooplankton production provided by BDCP conservation measures, the Implementing Entity will consider the range of possible adaptive management responses identified for each of the BDCP conservation measures. If the cause does not appear to be associated with the effectiveness of BDCP conservation measures, potential courses of action that could be undertaken by the Implementing Entity to increase zooplankton production, depending on the cause, may include:

- increasing the extent of habitat restoration that supports zooplankton production to increase overall production of zooplankton;
- controlling non-native competitors (e.g., clams) that remove zooplankton from the water column should practicable technologies become available over the term of the BDCP;

- increasing reductions of toxic contaminants through increasing implementation of BDCP other stressors conservation measures; and
- coordinating implementation of actions by non-BDCP parties if activities of those parties are the cause of low zooplankton abundance.

Additional more appropriate actions may be identified by the Implementing Entity through the BDCP adaptive management process based on the best information available to the Implementing Entity at the time an adaptive management response is under consideration.

Box #6

Conservation Measure WOCM2b: Operate the Fremont Weir to provide for a higher frequency and duration of inundation of the Yolo Bypass.

Box #7

Effectiveness Monitoring Metrics #1-3: Total organic carbon (mg/L), diatom density (mg/L), and zooplankton density (number/1,000 m^3)

Hypothesis: Increasing the frequency and duration of Yolo Bypass inundation will increase the abundance of zooplankton in Delta waterways by increasing the abundance of zooplankton produced in the Bypass and transported into Delta waterways and the abundance and transport of total organic carbon and diatoms transported into the Delta that will support increased production of zooplankton in Delta waterways. Total organic carbon, diatom, and zooplankton production within and exported from the Yolo Bypass into Delta waterways are primary constituents of food production for covered fish species (Sommer et al 2001a, Schemel et al. 2004). Measurements of these constituents, therefore, are indicators of the contribution of this conservation measure towards improving food production potential within the Delta.

Target: Increase total organic carbon concentrations in Yolo Bypass outflows relative to concentrations in flows passing over the Fremont Weir by at least __ percent, diatom density by at least __ percent, and zooplankton density by at least __ percent during periods the Fremont Weir is operated.

Adaptive management triggers and responses: If production and export of total organic carbon, diatoms, and zooplankton do not achieve the targets, the Implementing Entity will undertake investigations to determine causes for insufficient production and export of these constituents or determine if the targets

were established incorrectly given the uncertainties surrounding the internal and external factors that govern the capacity of the Bypass to produce these constituents. Potential actions, if appropriate, that could be undertaken to improve production and export of these constituents could include modifying Fremont Weir operations to increase hydraulic residence time within the bypass and operating the weir during warmer periods. Additional more appropriate actions may be identified by the Implementing Entity through the BDCP adaptive management process based on the best information available to the Implementing Entity at the time an adaptive management response is under consideration.

[***Note:*** *Additional performance and effectiveness monitoring that would be conducted for this conservation measure (e.g., establishment of inflow relationshps to water depth, inundation area, velocity, and residence time) would also provide information that would inform adaptive decision making relative to Effectiveness Monitoring Metrics #1-3.*]

Box #6

HRCM4: Restore a mosaic of __ to __ acres of freshwater tidal marsh within the Yolo Bypass/Cache Slough Complex Restoration Opportunity Area.

HRCM5: Restore a mosaic of __ to __ acres of freshwater tidal marsh within the Cosumnes/Mokelumne ROA.

HRCM6: Restore a mosaic of __ to __ acres of freshwater tidal marsh within the West Delta Restoration Opportunity Area.

HRCM9: Restore a mosaic of __ to __ acres of freshwater tidal marsh within the South Delta Restoration Opportunity Area.

HRCM10: Restore a mosaic of __ to __ acres of freshwater tidal marsh within the East Delta Restoration Opportunity Area.

Box #7

Effectiveness Monitoring Metrics #1-3: Total organic carbon (mg/L), diatom density (mg/L), and zooplankton density (number/1,000 m^3)

Hypothesis: Restoration of tidal marsh will increase the abundance of zooplankton in Delta waterways by producing zooplankton within restored tidal marsh channels that are transported into Delta waterways and the abundance and transport of total organic carbon and diatoms transported from restored marsh into the Delta that will support increased production of zooplankton in Delta waterways. Total organic carbon, phytoplankton, and zooplankton production within and export from restored tidal marshes into Delta waterways are primary constituents of food production for covered fish species (Sommer et al 2001a, Schemel et al. 2004). Measurements of these constituents, therefore, are indicators of the contribution of these constituents towards improving food production potential within the Delta.

Early Target: Provide for a year over year increase in total organic carbon and the mean abundance of diatoms and zooplankton sampled in Delta waterways adjacent to restored marshes during winter, spring, summer, and fall relative to total organic carbon, diatoms, and zooplankton present in the adjacent Delta waterways prior to restoration of tidal marsh.

Overall Target: Increase mean annual total organic carbon concentrations entering Delta waterways adjacent to restored tidal marshes relative to concentrations in the channels before marsh is restored by at least __ percent, diatom density by at least __ percent, and zooplankton density by at least __ percent by at least __ percent.

Adaptive management triggers and responses: If production and export of total organic carbon, diatoms, and zooplankton do not achieve the targets, the Implementing Entity will undertake investigations to determine causes for insufficient production and export of these constituents or determine if the targets were established incorrectly given the uncertainties surrounding the internal and external factors that govern the capacity of restored tidal marshes to produce these constituents. Potential actions, if appropriate, that could be undertaken could include modifying tidal marsh restoration designs to improve vegetative structure and composition and tidal exchange to improve production and export of these constituents.

Box #6

HRCM11: Restore a mosaic of __ to __ acres of brackish tidal marsh habitat within the Suisun Marsh Restoration Opportunity Area.

Box #7

Effectiveness Monitoring Metrics #1-3: Total organic carbon (mg/L), diatom density (mg/L), and zooplankton density (number/1,000 m^3)

The hypotheses, monitoring approach, and adaptive management triggers and responses for these metrics are the same as described for conservation measures HRCM4-HRCM10 , except that monitoring would take place within shallow subtidal habitats of Suisun Bay and Suisun Marsh sloughs adjacent to restored tidal marshes.

Early Target: Provide for a year over year increase in total organic carbon and the mean abundance of diatoms and zooplankton sampled in Suisun Marsh channels and Suisun Bay adjacent to restored marshes during winter, spring, summer, and fall relative to total organic carbon, diatoms, and zooplankton present in the adjacent waterways prior to restoration of tidal marsh.

Overall Target: Increase mean annual total organic carbon concentrations entering Suisun Marsh channels and Suisun Bay adjacent to restored tidal marshes relative to concentrations present in these locations before marsh is restored by at least __ percent, diatom density by at least __ percent, and zooplankton density by at least __ percent.